

5c 6

5

The Use of Digitalis in the Various Forms of Cardiac Arrhythmia

BY

HENRY A. CHRISTIAN, M.D.

BOSTON



REPRINTED FROM

THE BOSTON MEDICAL AND SURGICAL JOURNAL

AUGUST TWENTY-SIX

1915

The Use of Digitalis in the Various Forms of Cardiac Arrhythmia

BY

HENRY A. CHRISTIAN, M.D.

BOSTON

REPRINTED FROM

THE BOSTON MEDICAL AND SURGICAL JOURNAL

AUGUST TWENTY-SIX

1915



Digitized by the Internet Archive
in 2019 with funding from
Wellcome Library

<https://archive.org/details/b30800894>

[Reprinted from THE BOSTON MEDICAL AND SURGICAL JOURNAL,
Vol. clxxiii, No. 9, pp. 306-311, August 26, 1915.]

THE USE OF DIGITALIS IN THE VARIOUS FORMS OF CARDIAC ARRHYTHMIA.

BY HENRY A. CHRISTIAN, M.D., BOSTON.

IN recent years new methods have been available for studying cardiac action in man; methods which make possible an accurate analysis of the contraction wave, as it sweeps over auricle and ventricle, with a better understanding of disturbances in heart rate and rhythm. The polygraph and the string galvanometer or electrocardiograph are the instruments which have been of greatest service in this study. With them the action of digitalis on the human heart can be investigated with the thoroughness that is used in the pharmacological laboratory for animal experimentation, with the very great advantage that it is the human heart disturbed by natural disease that is being studied, not the normal heart of an animal or an animal's heart in which man's acquired disease is but crudely imitated.

It is my task this afternoon to place before you some of the results of this work. I will attempt to give an interpretation and an application to clinical practice of studies which have been conducted in many clinics rather than to report any new studies of my own. However, instead of analyzing the literature on the subject or quoting the opinion of others I will give deductions from this work as we have attempted to apply it to patients observed in the clinic of the Peter Bent Brigham Hospital.

Now if the application of the polygraph and

* Presented as part of a Symposium on Heart Disease at a meeting of The Massachusetts Medical Society, June 8, 1915.

electrocardiograph to the study of cardiac disorders is to be of any real usefulness to the general practitioner of medicine, the knowledge gained from such studies must be translatable into the terms of general practice, that is, brought into the range of such observation as is possible with finger, eye and stethoscope. I believe that by the use of very complicated and expensive apparatus we have acquired so much better knowledge of cardiac arrhythmias that we are in a position by very simple means to recognize accurately the common arrhythmias, and understanding better their mechanism we can apply in their treatment our therapeutic measures with far greater success.

Irregularity in heart action may arise in several ways. Normally the contraction impulse begins at a point in the region where the superior vena cava joins the right auricle and spreads over the auricle as a contraction wave. The contraction of the auricle originates an impulse which travels from auricle to ventricle along the conduction system or His bundle, and arriving at the ventricle starts almost simultaneously in many parts of the ventricles a contraction of ventricular musculature which drives out into the peripheral vascular system a certain amount of blood. Irregularity in heart action will result from disturbances at the point of origin of the impulse, in the auricle, in the conduction system or in the ventricle. For our purposes we need discuss only those arrhythmias which frequently are associated with or are the cause of cardiac decompensation. As with cardiac murmurs so with cardiac arrhythmias, it is the evidence of cardiac decompensation that should indicate the need for therapeutics, not the finding of an irregular pulse.

One of the most frequent arrhythmias in this sense of causing cardiac decompensation is auricular fibrillation, a condition in which the auricle instead of contracting regularly and rhythmically, at a rate of 70 to 90 per minute, is in a condition of very rapid fibrillary twitching with no functional contraction in the sense of squeezing its contents into the ventricle during the period of ventricular diastole. There being no orderly sequence of contractions in the auricles, these fibrillary twitchings are continually starting impulses along the conduction system of varying intensity, to only some of which can the ventricular musculature respond by contraction. The result is an extreme irregularity in the rate and force of the heart beat. The diagnosis can be made readily in most cases by feeling the pulse and finding an irregularity in rate and force which is without any suggestion of a dominant rhythm. If the patient shows signs of cardiac decompensation the stethoscope over the heart apex will reveal the same type of tumultuous irregularity in rhythm, and with the finger on the radial pulse there is a striking difference between apex rate and radial pulse because some of the weaker ventricular contractions fail to give an impulse to the blood stream that reaches the radial artery as a pulse wave. Finding a marked irregularity in pulse rate and a striking discrepancy between apex rate and radial pulse, the diagnosis of auricular fibrillation is justified. With auricular fibrillation digitalis almost invariably produces a striking effect, as shown by Fig. 1 and Fig. 2 unless the myocardium is damaged so extensively that no longer can it respond to the digitalis.

The effect of digitalis is to slow the pulse rate (Fig. 1) and to increase the work of the heart,

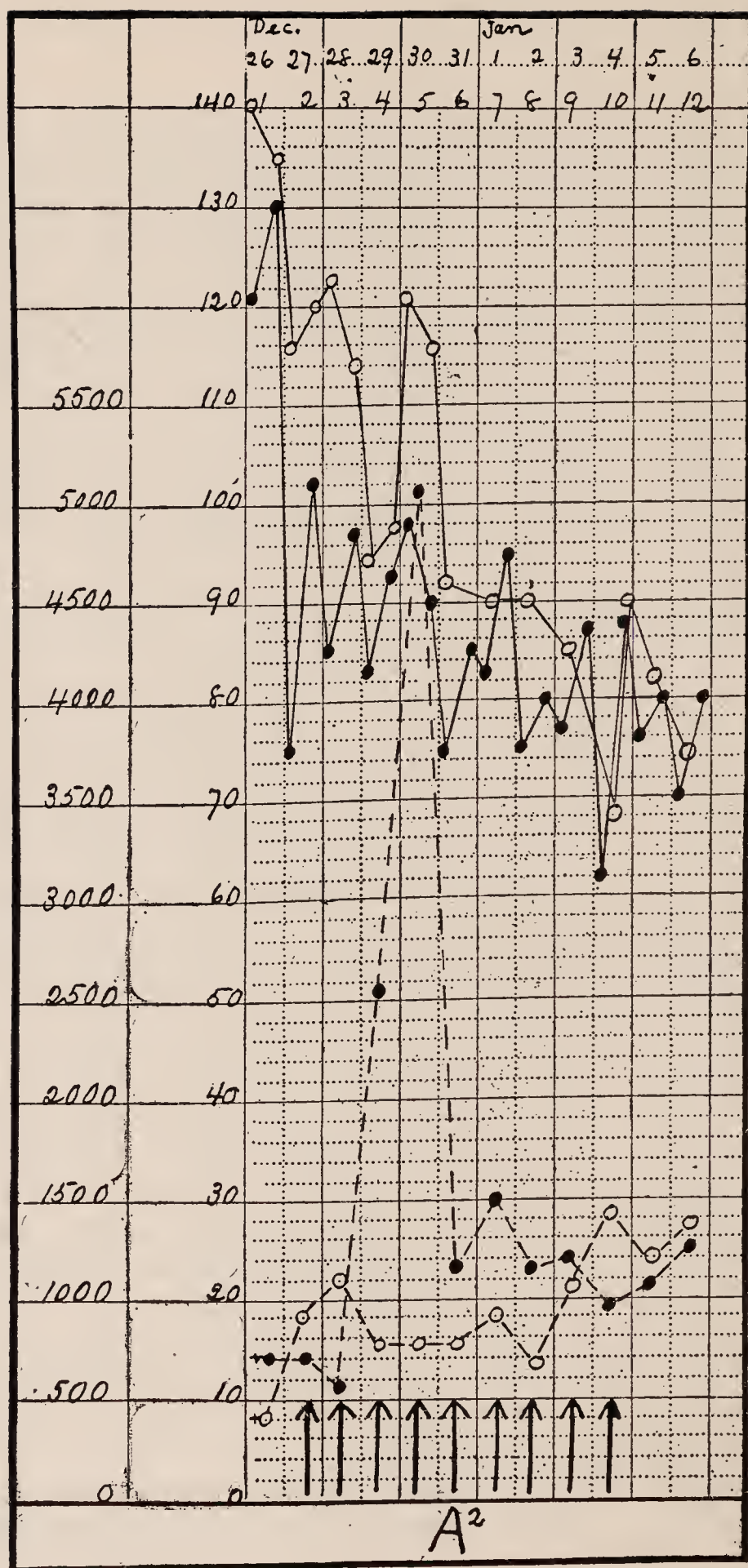


FIG. 1.—Patient with auricular fibrillation. Dots joined by solid line indicate radial pulse rate. Circles joined by solid line indicate apex rate. Dots joined by broken line indicate urine output in c.c. Circles joined by broken line indicate fluid intake in c.c. Arrows over A^2 indicate days on which the patient received three doses of 0.1 gm. each of powdered digitalis leaves.

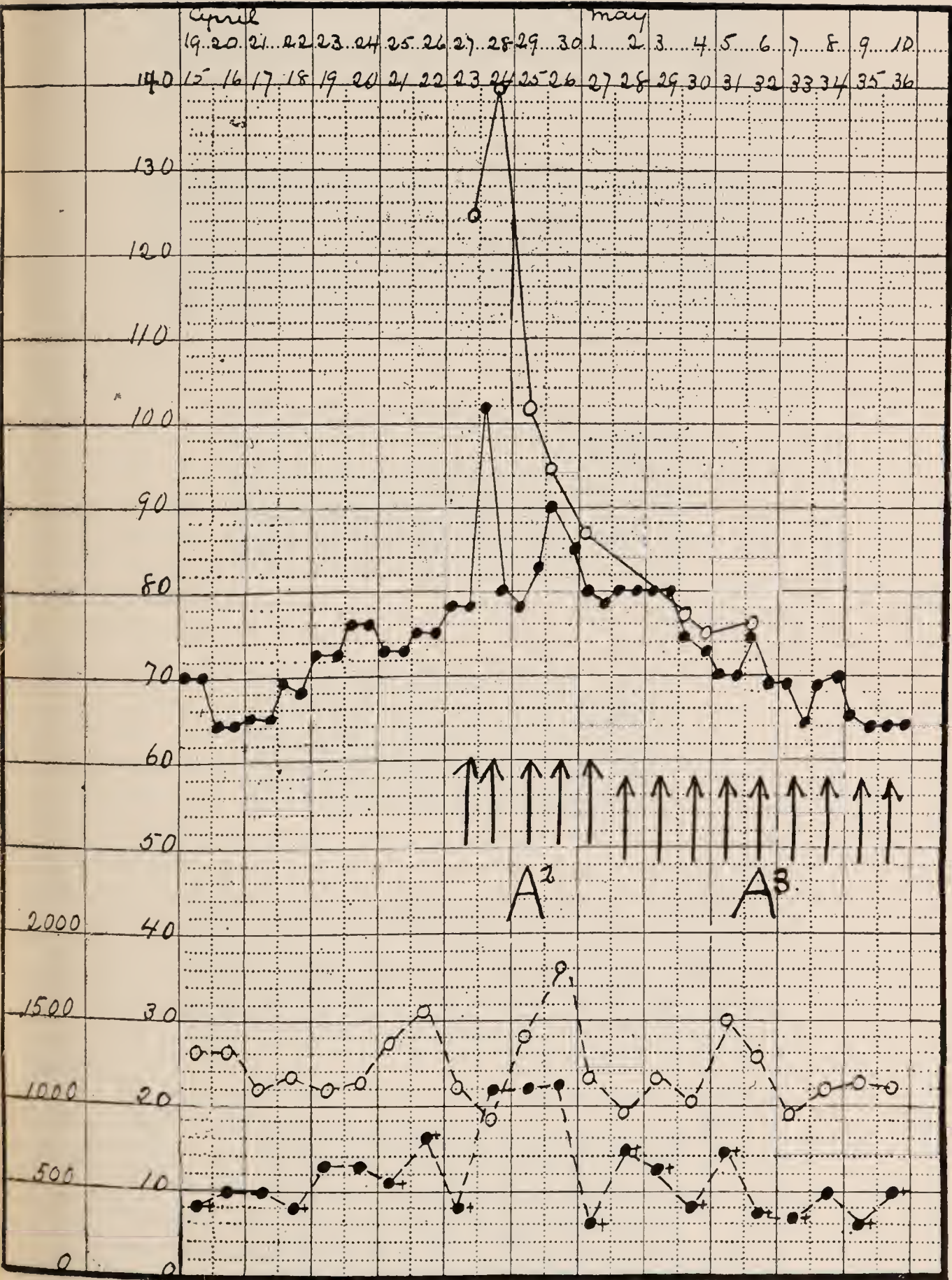
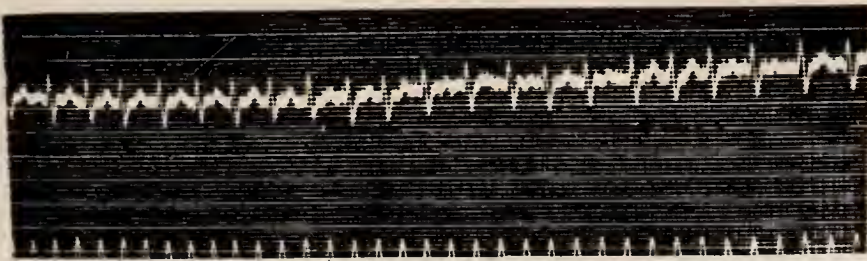


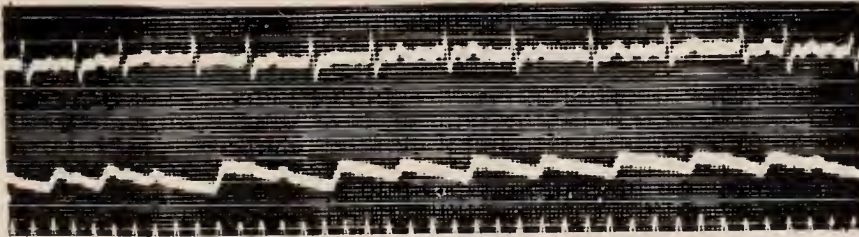
FIG. 2.—Patient with auricular fibrillation. Dots joined by solid line indicate radial pulse rate. Circles joined by solid line indicate apex rate. Dots joined by broken line indicate urine output in c.c. Circles joined by broken line indicate fluid intake in c.c. Arrows over A² indicate days on which the patient received three doses of 0.1 gm. each of powdered digitalis leaves. Arrows over A³ indicate days on which the patient received two doses of 0.05 gm. each of powdered digitalis leaves.

as shown by decrease in the signs of cardiac decompensation (edema, subcutaneous and pulmonary, ascites, cough, bronchitis, dyspnea, etc.). Sometimes there is a diuresis (Fig. 1); sometimes not (Fig. 2). A very important evidence of the beneficial action of digitalis is the decrease in the pulse deficit, *i.e.*, in the difference between apex beat and radial pulse (Figs. 1 and 2). In using digitalis it is particularly important to keep this effect in mind, for if one counts the radial pulse alone there may be no particular change in pulse rate, though the number of cardiac contractions has been materially decreased (Fig. 2). In fact, in this form of cardiac arrhythmia the counting of the radial pulse may be very misleading, it being within normal limits when actually the heart is beating very rapidly (Fig. 2). To count the heart beats with the stethoscope is the all-important thing, not the counting of the radial pulse.

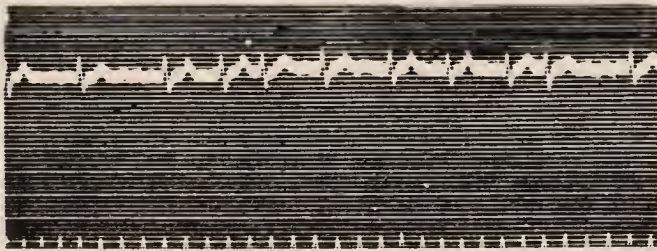
How does digitalis act in these cases of auricular fibrillation to improve the heart action? It is mainly an effect through the conduction system; digitalis impedes conduction in the His bundle, and the result is that fewer auricular contractions send through impulses to originate ventricular contractions, and so the ventricle beats more slowly. Beating more slowly, there is more time for the ventricle to fill and more time for the muscle to recover from fatigue, so the systolic output is increased. Probably also digitalis exerts an action on the myocardium, causing the contraction to be more forcible, and by its action it improves coronary circulation. Digitalis in these cases produces no effect on auricular contraction:—fibrillation continues as before. These effects are shown by the electrocardiograms (Fig. 3). If digitalis is pushed too



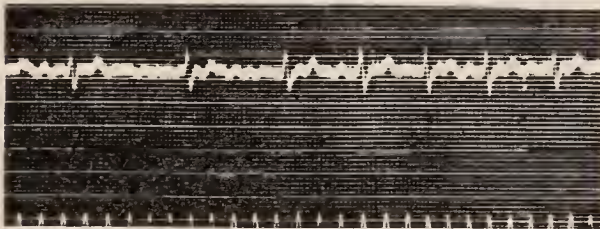
Dec. 21, 1914. - Rate 180 Powd digitalis = 0.2 gm



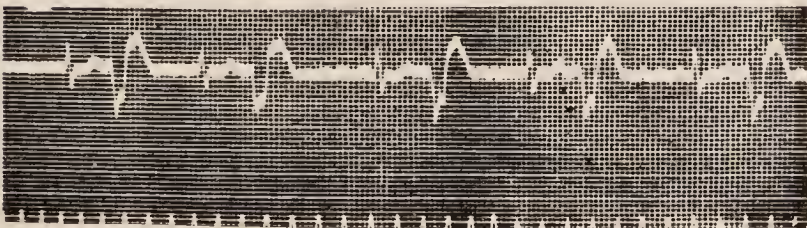
Dec 22, 1914 - Rate 96 Powd Digitalis = 0.5 gm



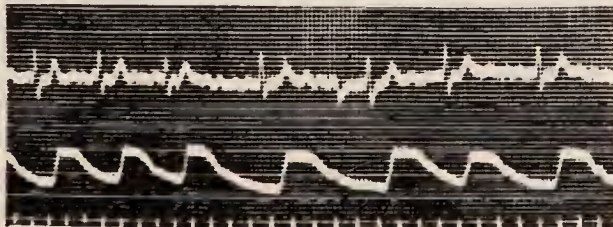
Dec. 23 1914 - Rate 96 Powd Digitalis = 0.8 gm.



Jan 6, 1915. - Rate 84. Powd Digitalis = 2.8 gm.
to January 2nd



Jan. 28 1915. - Rate 96 Infusion Digitalis
360 cc.



Jan. 28, 1915. Rate 84.

FIG. 3.—Electrocardiograms from patient with auricular fibrillation. Upper four curves show progressive effect of digitalis given in one period. The fifth curve shows bigeminy produced by digitalis given in another period. The sixth curve taken immediately after the fifth shows temporary character of bigeminy in this patient.

far, nausea usually develops as a ~~signal~~ for its omission. In other cases a characteristic toxic effect appears,—the pulse becomes bigeminal. Electrocardiograms show (next to last curve in Fig. 3) that this bigeminy is produced by a ventricular extra systole or ectopic beat, following closely after the regular ventricular contraction whose impulse has originated in the auricle. This condition is easily recognized with the stethoscope over the heart or by the palpating finger at the wrist. Whenever a coupling of the beats is detected with pauses of varying length between the couples and a pretty constant interval between the two beats of the couples, one can feel pretty sure of the existence of this toxic effect of digitalis in a case of auricular fibrillation. The condition may persist for some time or the rhythm may return quickly to its original form (see last curve Fig. 3), depending upon the severity of the toxic effect of the digitalis. The occurrence of this phenomenon is a sign, of course, for the omission of digitalis.

In some cases with auricular fibrillation in which edema is marked a much better diuresis is obtained by combining with the digitalis a diuretic drug, such as theocin (Fig. 4).

In another form of arrhythmia, namely, auricular flutter, digitalis usually produces a very striking effect. By auricular flutter is meant a condition in which the auricles are beating regularly and very rapidly, over 200 per minute (Fig. 5), too rapidly for the ventricle to respond to each auricular impulse. As the ventricle lags behind the pulse becomes slightly irregular, with a tendency for the irregularity to come in groups which repeat themselves. However, this condition usually is difficult of diagnosis except with the electrocardiograph. Digitalis in these

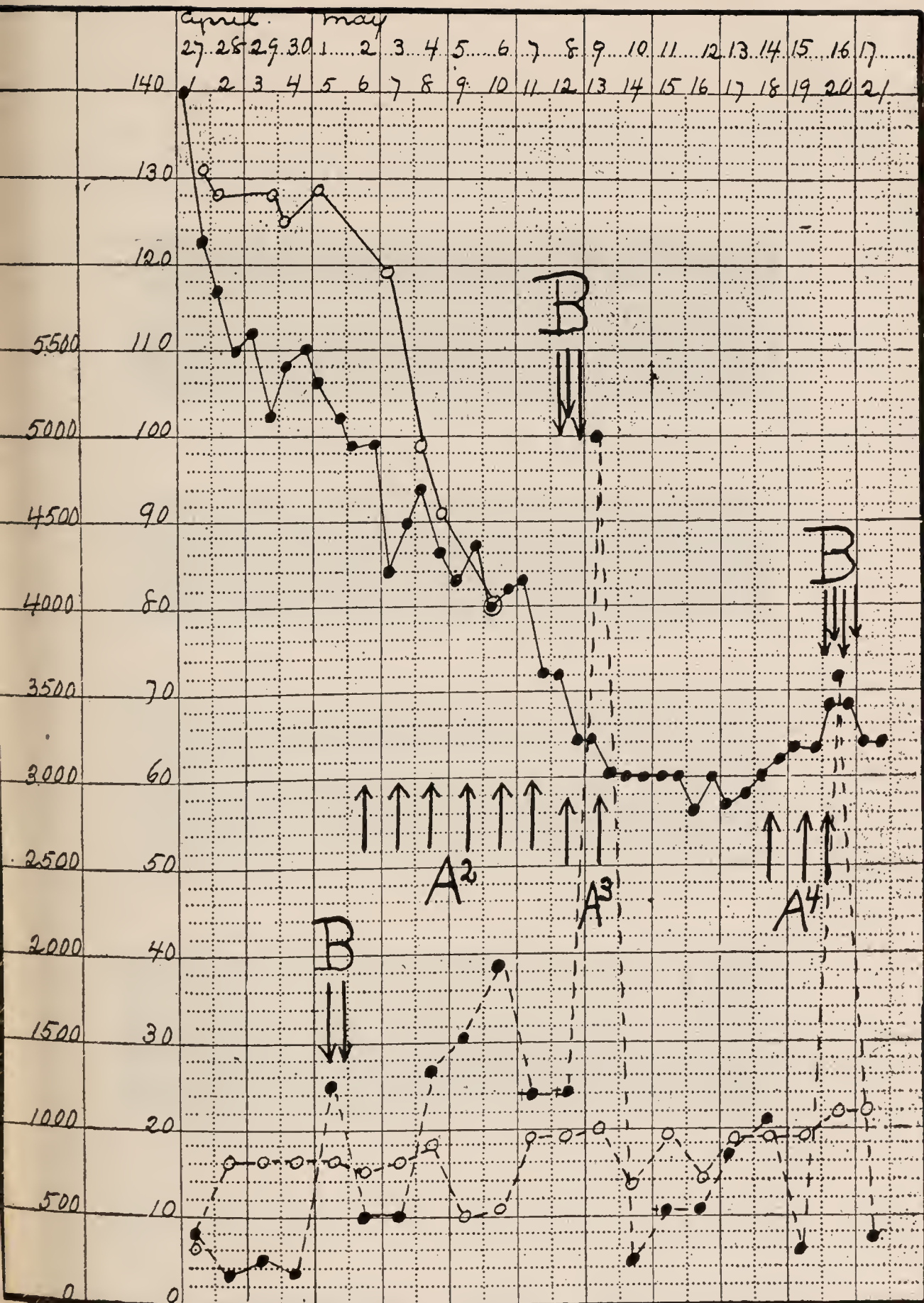
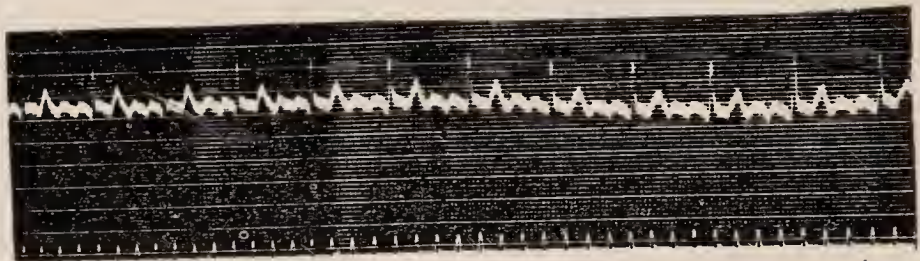
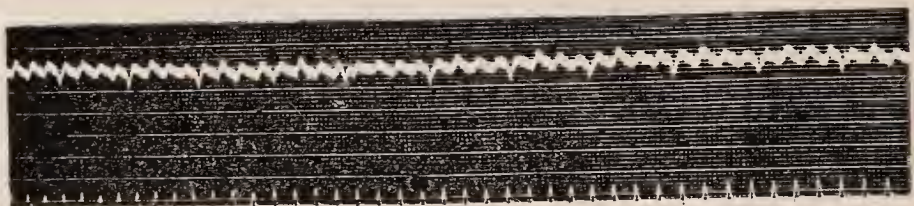


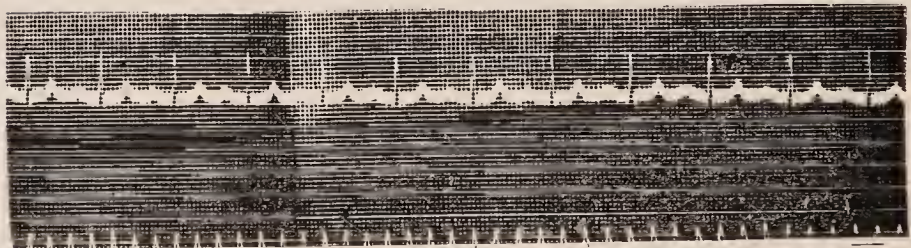
FIG. 4.—Patient with auricular fibrillation. Dots joined by solid line indicate radial pulse rate. Circles joined by solid line indicate apex rate. Dots joined by broken line indicate urine output in c.c. Circles joined by broken line indicate fluid intake in c.c. Arrows over A² indicate days on which the patient received three doses of 0.1 gm. each of powdered digitalis leaves. Arrows over A³ indicate days on which the patient received two doses of 0.05 gm. each of powdered digitalis leaves. Arrows over A⁴ indicate days on which the patient received three doses of 10 c. c. each of infusion of digitalis. Arrows under B indicate doses of 0.5 gm. each of theocin.



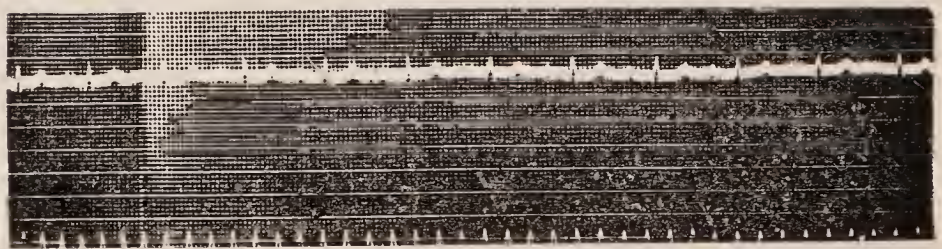
Lead II - Jan 11, 1915. Infusion Digitalis 90cc



Lead III - Jan 11, 1915. "V" rate = 84
"A" " = 336



Lead II Jan 15, 1915 Infusion Digitalis 190cc.



Lead III - Jan 15, 1915 "V" rate 84.
"A" " 84

FIG. 5.—Electrocardiograms from patient with auricular flutter. Two upper curves show Leads II and III while in flutter. Two lower curves show Leads II and III after return to normal rhythm.

cases either throws the auricle into fibrillation and when digitalis is stopped the normal rhythm is restored, or the heart slows down directly into a normal rhythm with great improvement in the patient's condition.

The action of digitalis in flutter is a twofold one. There is an action on the auricle which disturbs the ectopic focus of impulse formation, which is responsible for the very rapid auricular beat, either in inhibiting it and allowing the normal pace maker to regain control, or by generally disturbing the auricle so as to produce fibrillation, from which normal rhythm is restored. In addition there is an action on the conduction system and ventricular muscle such as occurs in auricular fibrillation cases.

In these two forms of arrhythmia the effect of digitalis is more constant and more striking than in any of the other common types of arrhythmia.

In pulsus alternans frequently digitalis produces good results. In true pulsus alternans the pulse is regular in rate but every other beat is weaker than its predecessor (Fig. 6). In such a case the pulse rate may be definitely slowed by digitalis (Fig. 7) with much improvement in the patient's condition. It is to be remembered, however, that a pulsus alternans is a sign of a very much impaired myocardium, and when the myocardium is greatly impaired the likelihood of functional improvement from digitalis is much decreased. To push digitalis in such a case may do much damage. Here it is particularly difficult to judge how far to carry digitalis therapy if no evident effect is produced. It would seem that in many of these cases the margin between no therapeutic effect and a serious toxic effect is a very narrow one. The same

thing holds true for the rapid, regular, though decompensated heart.

In the rapid, regular, decompensated heart digitalis, when it acts, appears to have a three fold effect. It slows the rate by increasing vagus inhibition and by increasing conduction time between auricle and ventricle (Fig. 8), and

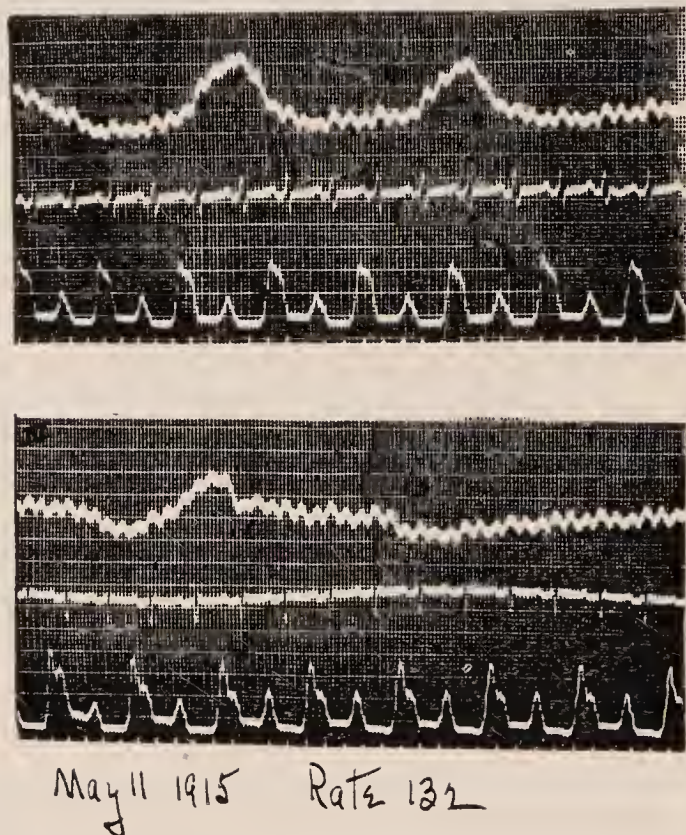


FIG. 6.—Curves from patient with pulsus alternans. Upper set of curves shows arteriogram below, electrical pneumogram above and electrocardiogram from Lead II in middle. Lower set of curves shows same except electrocardiogram is from Lead III.

it strengthens heart action by some direct action on the myocardium and coronary circulation. This type of case often seems definitely resistant to digitalis and the patient may take large amounts before any effect can be detected. It is always well to remember in such cases to watch the patient carefully, for sometimes the

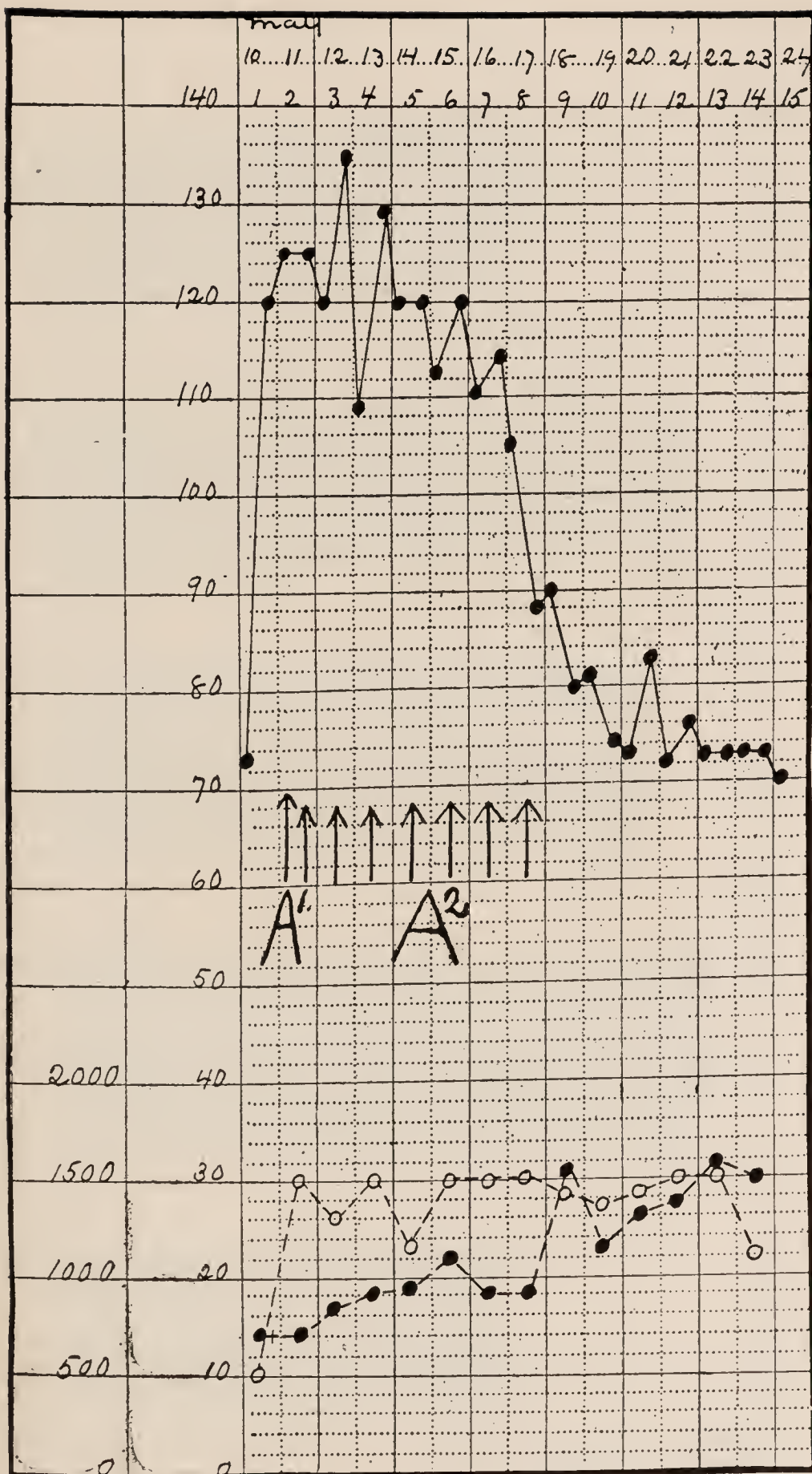
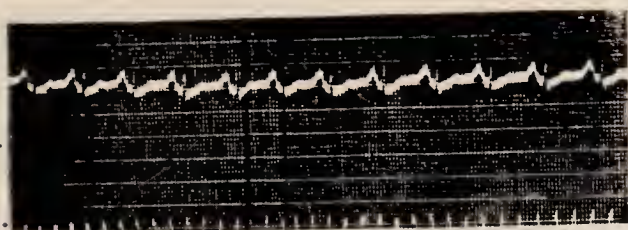


FIG. 7.—Patient with pulsus alternans. Dots joined by solid line indicate radial pulse rate. Dots joined by broken line indicate urine output in c.c. Circles joined by broken line indicate fluid intake in c.c. Arrow over A¹ indicates intramuscular dose of 1 c.c. of digipuratum. Arrows over A² indicate days on which the patient received three doses of 0.1 gm. each of powdered digitalis leaves.

digitalis action, which has been long delayed, develops with great rapidity into marked activity so that the patient, who shortly before has shown no digitalis effect, quickly develops toxic symptoms.

In paroxysmal tachycardia there is very little evidence that digitalis produces any good effect. In sinus arrhythmia and in compensated hearts with ectopic beats or extra systoles digitalis is not indicated. Sinus arrhythmia is easily recognized by palpating finger or stethoscope as a rhythmic variation in interval between successive beats, frequently a rhythmical variation synchronous with respiration. Extra systoles or ectopic beats are familiar to you as dropped beats. Two beats come rather close together and the second of these is followed by a lengthened pause. The extra systoles usually come at no fixed rate. Both these types of arrhythmia occur often in hearts with no other evidence of disturbed function, and their presence calls for no digitalis therapy. In decompensated hearts with a moderate number of extra systoles digitalis is indicated and acts much as it does in the decompensated heart with regular rhythm. When extra systoles are so numerous that cardiac decompensation appears to be largely a result of the arrhythmia, much caution is required in using digitalis because there is some evidence that digitalis at times increases the number of extra systoles and makes matters worse. However, this question of the exact relation of digitalis to extra systoles is one still under discussion. In most cases extra systoles are more an incident in, rather than a cause of, cardiac decompensation, and their presence can be neglected in considering the probable efficiency of digitalis therapy.



Pow'd
Digitalis =
= 1.4 gm.

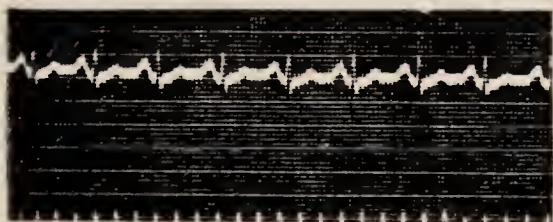
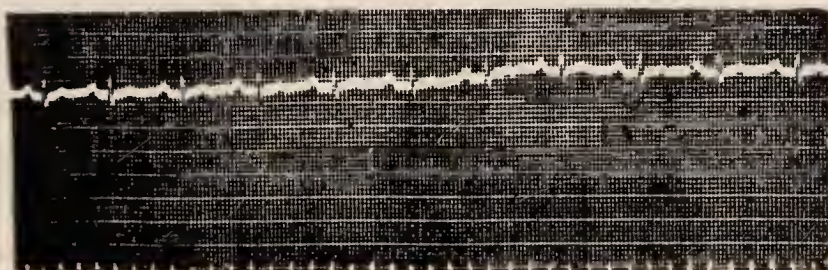
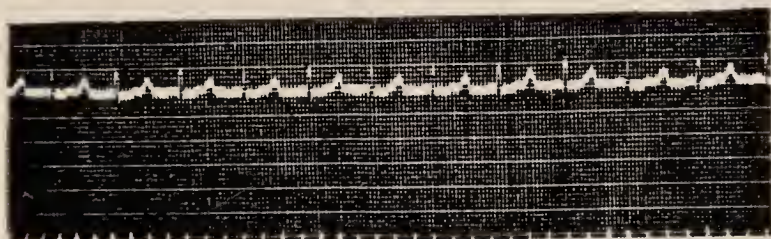
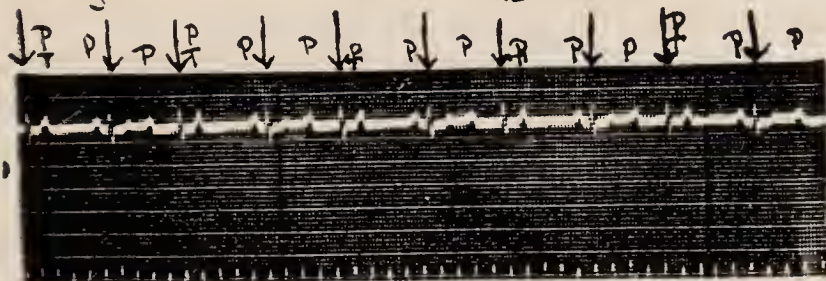


FIG. 8.—Electrocardiograms from patient with regular rhythm showing effect of digitalis on conduction time between auricle and ventricle. The second curve shows a partial block in conduction.

In cases of heart block not of digitalis origin, digitalis should be tried if the patient is decompensated. Results are sometimes very good; at other times it would seem that the patient is made worse. Trial must be made to determine this. So digitalis should be applied, but caution in its use in heart block is necessary.


It is rather beyond the province of my part in this symposium to discuss the various forms of digitalis. However, it seems to me that the all-important things are to see that the form of digitalis used is an active preparation and to use it in sufficient dosage to get effects. In my own judgment various digitalis preparations are interchangeable in ratio of their potency, rate of absorption being equal, and consequently it makes no difference what form you use provided you use it in the proper kind of a case in sufficient dosage. Any form used by mouth in ordinary dosage will require more than 24 hours to produce an effect. A form of digitalis preparation suitable for intravenous use so introduced into the body will begin to produce an effect in a few hours, often within one hour, and this form is indicated where prompt actions are required. Subcutaneous use gives an effect less rapid and less certain than intravenous use. Furthermore, most of the preparations which are potent are apt to be irritating when introduced subcutaneously. It seems to me that when quick action is required or the patient is vomiting and cannot retain the drug, intravenous use is preferable to subcutaneous. In the hospital I have the apothecary purchase good powdered digitalis leaves, whose potency I find out by using them in patients such as cases of auricular fibrillation in which digitalis ordinarily works well. If I get good effects I know that lot of digitalis is potent.

In the form of powdered leaves or freshly made infusion I find I can treat effectively the large proportion of cases with cardiac decompensation. For simplicity I use only these two forms of digitalis for mouth dosage. Occasionally a case requires a prompt action or is vomiting. In such a case I use strophanthin intravenously, with due regard to the necessary caution against using strophanthin in a patient who has been taking digitalis by mouth. Very occasionally it seems desirable to use some form of digitalis subcutaneously. For this I choose liquid digipuratum. I can see no advantage in multiplying the number of preparations of the digitalis group beyond this until new knowledge has come to throw light upon cardiac therapy which will enable us to select active components of the digitalis bodies to fit the needs of certain types of cases. As to dosage, relatively large doses should be used in periods of decompensation. With compensation restored very small doses continued over long periods certainly seem to be of great help in maintaining compensation. Much clinical experience supports this, and the recent electrocardiographic studies of Cohn and others show that the digitalis effect on the heart muscle is long continued after dosage has ended, and presumably with a continuation of small doses this effect is maintained.

If you use a single digitalis preparation which you know to be active by mouth and use it in a dosage which you have learned to be effective it seems to me you have solved the problem for all cases except those requiring intravenous or subcutaneous digitalis therapy, and these latter are few. If, in addition, you have chosen a potent preparation for these occasional requirements, it seems to me you are in a position to toss into the

waste basket all samples and literature on improved preparations of digitalis. You can reduce it to two forms, one for mouth use and one for intravenous use, and get as good results as any of your colleagues if you select the suitable type of case in which to push your digitalis therapy. One good preparation for mouth use with common sense and a knowledge of cardiac pathology and physiology will suffice for the successful treatment of most of your cardiac cases.

I would suggest that you have a reliable druggist keep in stock for you in powdered form a good digitalis leaf whose efficiency you know from using it on your own patients. From this leaf have him fill your prescriptions of pills of powdered leaf or fresh infusion. Equally well might you use tincture, but its preparation requires considerable time. Insist that your patients have their prescriptions filled by this one druggist. Doing this I believe you will improve greatly the results you obtain from digitalis, and digitalis properly used in cardiac disease is a most effective remedy, an all-sufficient answer to those who have no faith in therapeutic measures.

PRESS OF
JAMAICA  PRINTING
COMPANY
BOSTON, MASS.